Structural studies of graphite-like CNx films deposited on silicon by chemical vapor deposition of 1 H-1,2,3-triazole

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Abstract

In 1989, Liu and Cohen[1] presented firstly theoretical calculation for C_3N_4, a new hypothetical material and suggested that it should be metastable and possesses extreme hardness, wide band gape, high velocity of sound, large thermal conductivity, low dielectric constant, and low friction coefficient. They also predicted its outstanding mechanical properties. Graphite like carbon nitride composed of only sp^2 hybrids has recently attracted much attention. However, there have been few works so far which show the synthesis of graphite-like carbon nitride. In this paper, we report on the synthesis of graphite-like CN_x by micro-wave plasma enhanced chemical vapor deposition (CVD) method. 1 *H*-1,2,3-triazole + N_2 and Si (100) were used as precursor and substrate, respectively. The details of the experimental procedures are described elsewhere[2]. Substrate temperature during the deposition was recorded to be 850 °C. The deposited films were characterized with respect to crystal structure and states of chemical bonding by x-ray diffraction (XRD) and x-ray photo-electron spectroscopy (XPS) analyses, respectively. XRD observation (Figure 1) strongly suggests that the films consist of graphitic (Gr.) C_3N_4 (002), (200) and (004) with small contribution of Gr. carbon (101)[3]. Narrow scans of C(1s) and N(1s) photoelectron peaks are depicted in Figure 2(a) and 2(b), respectively. Four deconvoluted peaks of C(1s) (Fig. 2(a)) at 284.8 (peak 1), 285.8 (peak 2), 286.8 (peak 3), and 288.3 eV (peak 4) are attributed to adventitious carbon, sp^2C-N, sp^3C-N, and C-O bonding structures, respectively[2]. On the other hand, five deconvoluted peaks of N(1s) (Fig. 2(b)) at 397.9 (peak 1), 398.9 (peak 2), 399.8 (peak 3), 400.5 (peak 4), and 402.0 eV (peak 5) are attributed to N (1s)-Si, N-sp^3C, N-sp^2C, N-N and N-C bond in a variable stoichiometry, and N-O bonding structures, respectively[2]. CN_x with sp^2 hybrid structure is dominant in the deposited films which are shown in Figs. 2(a) and 2(b). These observations support that 1 *H*-1,2,3-triazole favors the formation of graphite-like CN_x films and thus is in good agreement with XRD results. We do propose that 1 *H*-1,2,3-triazole can be used as an important promising precursor for CVD to deposit graphite-like CN_x films.

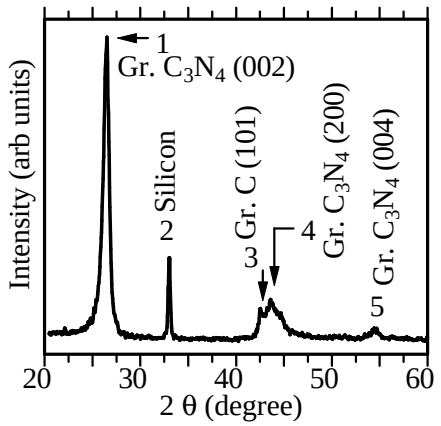

Figure 1 XRD spectra of CN_x films deposited on Si (100).

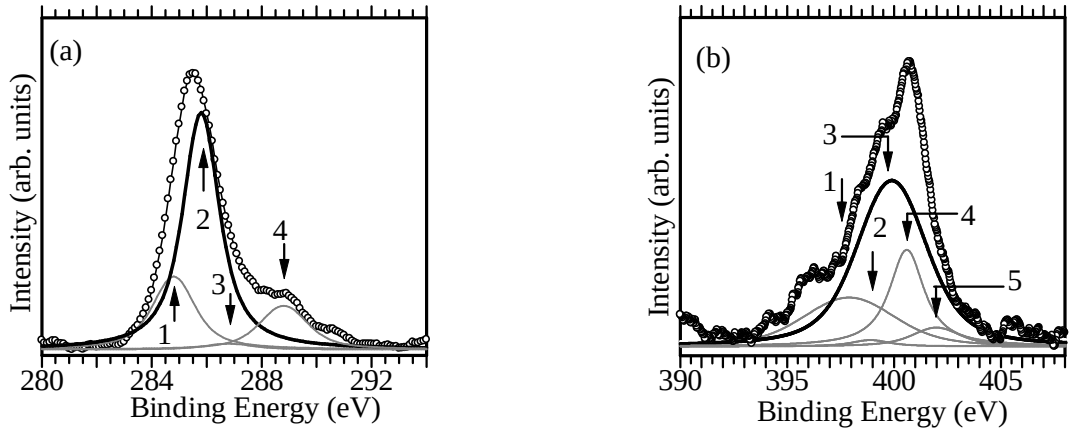

Figure 2 XPS scans of (a) C (1s) and (b) N (1s) for the CN_x films deposited from 1 H-1,2,3-triazole+N_2 on Si (100).

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